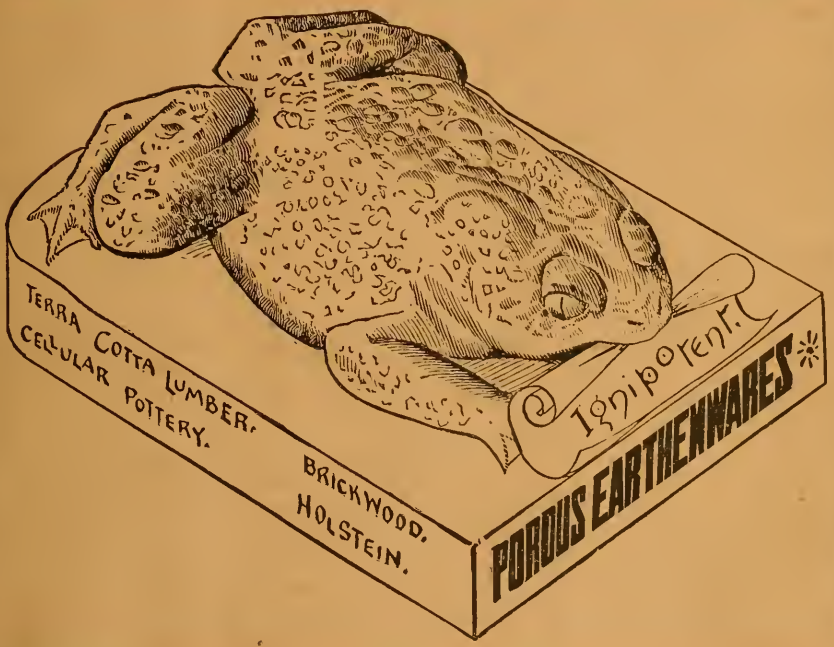
MANUFACTURERS' MANUAL



ISSUED BY

The International Terra Cotta Lumber Co.

Office: 115 Dearborn Street,

CHICAGO, ILL., U. S. A.

JANUARY 1st, 1887.

PITKIN & VAUGHAN CO., Printers, 102 Washington Street, CHICAGO.

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INDEX OF CONTENTS:

CHAPTER I.....Page 1

POROUS EARTHENWARES.

"Terra Cotta Lumber," "Brickwood," "Cellular Pottery," "Holstein."

CHAPTER II.....Page 4

Their Production as a New Industry.

CHAPTER III.....Page 7

Their Manufacture.

CHAPTER IV.....Page 10

Formulas.

Preparation, Milling, Pressing, Drying, Firing, Tooling.

CHAPTER V.....Page 13

Clays and their Treatment.

CHAPTER VI.....Page 26

The Protection Afforded by Letters Patent.

CHAPTER VII.....Page 28

Profitableness of Manufacture.

CHAPTER VIII.....Page 30

Construction of Plant.

GENERAL INFORMATION.....Page 35

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THE

International Terra Cotta Lumber Co.

(Successors to THE GILMAN POROUS TERRA COTTA CO.)

C. C. GILMAN, President, Eldora, Iowa.
Hon. EDMUND RICE, 1st Vice-President, St. Paul, Minn.
GEO. E. GILMAN, 2d Vice-President, Chicago.
DICKERSON & DICKERSON, Counsel, New York City.
ALFRED ENNIS, Counsel, Chicago,
BEHRENS & CADY, Solicitors, New York City.
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OFFICES:

115 Dearborn St., Chicago, Ill., U. S. A.

Proprietor of American and Foreign Patents, Protecting the Manufacture and Specific Application of

POROUS * EARTHENWARES,

"Terra Cotta Lumber," "Brickwood," "Cellular Pottery," "Holstein."

A New and Promising Industry, Patented in every detail.

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PAYABLE WHEN SOLD.

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To Canvassers of Means and Standing,

Lucrative Positions will be afforded, for the purpose of introducing the manufacture in this and other countries.

INFORMATION.

RELATIVE TO POROUS EARTHENWARES

AND THEIR VARIED APPLICATIONS.

PUBLISHED BY

The International Terra Cotta Lumber Co.

115 Dearborn St., Chicago, Ills.

AND FURNISHED FREE TO APPLICANTS.

No. 11. *"THE MANUFACTURERS' MANUAL,"*
Descriptive of processes of manufacture.

No. 12. *"THE BUILDERS' HAND-BOOK,"*
Descriptive of application in Incombustible Architecture.

No. 13. *"SPECIFIC ADAPTATIONS,"*
Descriptive of uses in the Arts and Sciences.

CHAPTER I.

POROUS EARTHENWARES

is the generic name applied to, and descriptive of, the patented products obtained by Gilman's several methods of manipulating earthy and vegetable matters together with water, pressing and drying the same, and by subsequent firing expelling the combustible matters, leaving as a residue, a porous bricken material possessing largely in combination the characteristics of both wood and brick, the formulas for making which will be found in succeeding chapters.

"TERRA COTTA LUMBER"

ranks as the first invention because of priority of discovery, and as such has afforded in a measure, a trade-mark in its name for the protection of the manufacture of porous earthenwares.

Re-issued United States patents were granted in 1883.

Immediately upon its introduction to the public, the new material took high position as a fire-proofing for the interiors of the modern colossal structures which about this time began to appear in the City of New York, and for that purpose was at the time, and is now, unequalled by other.

But the kaolinic clays of which it is made, require a very high heat to reduce them, in the firing process, and the cost of the fuel over and above the saw-dust contained in the mixture, is estimated to be equal to one dollar for each ton of product. Besides, their deposits are found in comparatively few districts, in this or other countries; a serious bar to the introduction of a cheap material into general use.

Said a prominent New York architect, after using it in his practice a year, at the rate of fifteen to twenty dollars per ton, "Give us something as good as brick, at half its weight and no greater cost, and we will be in every way satisfied."

Ingenuity was again taxed, new machinery invented, and other experimental mixtures and processes intelligently ventured upon

As a result, a product made from surface clays, gritless or otherwise, mixed homogeneously with sawdust of any kind, was introduced upon the market in St. Paul, Minnesota, in the season of 1884, which manufacture was at once pitted against bricks and lumber as a common building material for house interiors. Patents have been allowed for this invention and the specific name since claimed for it is

"BRICKWOOD."

"The heavy power, expensive grinding mills, and costly down-draught kilns, necessary to the working of fictile clays, have been to a great extent done away with in this production, and a cheap plant, with the up-draught kiln of the brickmaker substituted therefor; for it was found that the vegetable matters imprisoned in the dried, pressed material, served adequately as a fuel after ignition, to bake the clay residue. A notable manufacture, in which one refuse substance converts another substance, by cheap mechanical processes, into an article of value, and which very likely can never be superseded on the score of simplicity and cheapness.

Nor did invention cease here. Mexico demanded a cheap substitute for stone and adobe, for the construction of clean cool houses, in which insect, vermin and reptile life could not find harborage. But Mexico has little timber and few saw-mills. Something must be found to take the place of sawdust? Further experimentation was had, and developed the fact that straw or hay, cut into short pieces, could be worked with clay under a new mixing and pressing process, and furthermore, by accident it was discovered that, if the straw or its equivalent should be cut into lengths, as much as two or three inches, the action of the press upon the plastic mass as it passed through the dies peculiarly affected the particles, and caused them to arrange themselves parallel with each other, and horizontal with the general line of motion pursued by the pressed material through and out of the dies, virtually creating a fibre uniformly distributed throughout the clay, strained to its utmost, which closely held together the green product in the drying stage, making it possible to express pieces in the shape of slabs, joists and scantling, as long as ten or twelve feet, the tenacious hold of the fibre compelling the shrinkage of the product accompanying drying, to take place within itself, instead of cracking, as is the case with granular or saw-dust mixtures.

"CELLULAR POTTERY"

is the name distinctively applied to this third invention, and for it a patent has been allowed. Inductive reasoning led to the fourth and last invention of composition of matter of this character, which in the end may prove of the greatest utility of any.

"HOLSTEIN,"

as rendered into English, Wood-stone, for which patents are pending.

It seemed quite plain to the inventor, that if a fibre could be created of straw to safely hold pure clay in drying, a like treatment would compel like results in the Terra Cotta Lumber and Brickwood mixtures, which undergo the process quite as, if not more, tenderly. And if so, why is not the making of large blocks for outside walls, impracticable with granular mixtures, on account of their tendency to rend in drying, made possible? And so it proved. A sprinkling of cut straw added to the saw-dust mixture enables the safe pressing and drying of hollow blocks several feet in length and a foot or more square and weighing, when green, as much as one hundred to one hundred and fifty pounds, which, subsequent to firing, are susceptible of easy tooling, and when erected in the wall, may, by the application of granular mineral waterproof coating, be made to closely resemble blocks of stone or marble, but unlike them, prove quite impenetrable to heat, cold or moisture, and require no furring or lathing on their inside faces to retain the interior plastering finish.

The last two of these inventions are of too recent origin to allow in this work a practical demonstration of that which is believed possible in the near future, *i. e.*, a building complete in every detail, in which, in construction and finishing, not a particle of combustible matter shall be allowed to enter; but it is confidently held by thinking men that the anxiety existing relative to the rapid disappearance of our forests may cease, as the bared bosom of Mother Earth now offers an adequate substitute, to be more valued, for out of the clay and clayey loams of *everywhere*, and the vegetation which flourishes thereupon, may be fashioned with cheap power and unskilled labor, *incombustible lumber*, varying in characteristics as much as those observed in woods, and as widely as exists between the toughest oak and softest pine; with which the future shall house the masses.

CHAPTER II.

THEIR PRODUCTION AS A NEW INDUSTRY.

Over production is our Nation's present sore spot. Farmers find it so in the low prices for grain; manufacturers in unremunerative production; merchants in killing competition; mechanics in cut wages, and laborers in lack of occupation.

In times gone by, when unlimited capital was obtainable by few, and patented machine power displaced handcraft, the manufacture of staples *paid*, where that industry thrived; so did all other business pursuits from sympathy; prices were high and money abundant; the industrious, frugal worker could hoard a portion of his wages.

But in these days, the same labor and thrift is demanded of the bread-winner to keep him out of the poor-house. Remedy. New markets must be found, or the ranks of manufacturers decimated! The manufacturer of modern labor, life, and money saving devices is an exception. The reason? Because his wares are protected by patents, and, without fear of competition, he can demand and obtain remunerative prices. He prospers accordingly, and so do those about him.

Few *staples* are protected in their manufacture—this protection is accorded to new inventions only. By the time an invention is fairly on the market, a recognized necessity, *i. e.*, a staple, the protection under our patent laws, ceases by limitation. Seventeen years of unceasing industry, of prodigal expenditure of brains and money, have taught the world to use a new *something*, contributory to its comfort and happiness, and then the patented novelty becomes a staple, and its free manufacture is thrown open to all.

Instances of the invention of a new valuable material, or a new composition of matter, are rare. "The world is *so old*," and this slur of the litigant infringer passes affirmatively and unrebuked, until stopped short by the fiat of the last Court of Appeals. Usually it is the patented gimcrack, the thing of an hour which dis-

penses quick fortunes; for a single manufacturing plant and the labor of a hundred men will supply it, to the world. Of course there are exceptions; Bessemer steel affords one, and eminently. Wherever iron ore abounds, the Bessemer steel plant, roots and thrives. The manufacturing site may be one abandoned by the iron-master, because of remorseless competition and a glutted market. They offer no objection to the establishment of the new invention. Old manufacturing devices are discarded for new, the fires are rekindled and success dominates where before, failure nervelessly ruled. And why? The production has been fostered by the law of the land; for a multitude of purposes it is superior to iron, and to the consumer cheaper; it is so closely allied to it, that exhaustive argument is not required to demonstrate that it *is* iron, a staple, and not a short-lived makeshift; the same skill and labor required to produce iron creates it; its specific application in the arts and sciences differ not, and withal, its market, at remunerative prices, is found at home.

Thus a twist of the wrist, a slight change in the manipulation of raw products; and a revolution threatens the world? Wooden ramrods served every purpose, until the one of iron, the invention of Leopold, Prince of Anhalt, Dessau, in 1715, gave the Prussian soldiery acknowledged mastery of Continental Europe, and Frederick Wilhelm his distinguished appellation; "The Great."

The same arguments and others equally cogent, inspire economists with the belief, that the future manufacture of porous earthenwares, will, in a measure, rapidly and profitably supersede the production of lumber for cheap house-building.

Process, product and application architecturally, is patented in every detail. The protection against ruinous competition is perfect. The raw ingredients have no commercial value—they are wastes, refuse, and always will be, in their accumulation; there are no ore royalties, or timber stumpages, to pay, which, gradually increasing in value, licks up in time the manufacturers' margin, in fact, the manufacturer himself; for where soil exists there are they to be found without cost, beyond that contracted for their gathering. The simplest machinery works them, unskilled hands work the machinery.

Thus, from the nature of things, the industry cannot be cheapened by new inventions, or improvements on old ones. Wherever new buildings are erected, and burned ones are replaced, there exists the market, be that improvement in the commercial city or the western town. The material is made at home, sold at home, and the demand never satiated.

Mixtures made of these latter described earthy matters, demand a cherry red heat in firing—say something less than 1000 deg. F.—to bring them to a proper body, *i. e.*, incipient vitrifaction; a stage usually reached by the combustion of the imprisoned vegetable matter alone.

It is the experience of all brick-makers, that clays closely resembling each other in analysis, often disclose differences in a fire test, as regards the amount of heat required to bake them; therefore, in this case no general rule for additional fuel consumption, may be laid down as absolute.

The presence of metallic oxides, of lime and magnesia, when pulverized by grinding or rolling, is not necessarily injurious to the product; on the contrary, they often assist as fluxes under low firing, thereby strengthening the production.

Furnace linings and fire bricks, in view of their intended future uses, must be made of fire clays proper, for though it is true that porosity confers non-conducting properties of a high order, and to an extent which will counter-act the natural warping and shrinking tendencies of burning products, refractoriness to severe action of melting heat is not materially enhanced thereby.

Of vegetable matters, sorts which refuse to crush into nothingness, or to lose their identity in the preparatory processes, are required; and when feasible, these should be of two forms; granular like saw-dust and fibrous like straw or its equivalent.

After the mixtures are formulated by pressing, and are dried and submitted to the fire, the vegetable particles are burned away, leaving the clay body behind, numerously occupied by empty cells of like body and size.

Nor are the good offices of these combustive matters, limited to creating porosity of the burned product, or co-acting with the fuel used for burning, as is particularly the case with saw-dust, for by their liberal intermixture the clay is deprived of its inclination to warp in drying, when exposed to the sun and wind, or to a sudden elevation of the temperature.

Instances have been known also, when the mixtures have frozen dry. In such the green material was suffered to remain undisturbed, until freezing was succeeded by thawing, and thawing by drying.

It is in the green stage of the material, after pressing, that the employment of fibrous matters causes it to display functions, notably wanting, where granular matters alone are used. Reduced by machines into lengths of two inches, or thereabouts, the straw cut-

ting, assume a position longitudinal with the line of motion of the plastic mass, as it is forced resistingly through the press and dies, a result consequent upon the friction encountered in its passage; thus endowing the otherwise frail body with a tenacious fibre, which affords a tensile strength in proportion to the supply of straw, and the thoroughness of its distribution throughout the clay.

Thus effectually tied together, the pressed compound is rendered close-bodied, tough and elastic, and the ordinary dangers to be apprehended in the dry stage, of cracking and warping, averted.

This phenomenon is peculiar, however, only to "presses of expression." The exclusive use of fibrous matter, is of course, dictated by necessity, where saw-dust is unobtainable, and the same may be said of saw-dust in localities, where the scarcity of hay and straw render their use for the purpose too expensive; but a modicum of the one, added to either mixture, will warrant the extra outlay. From a plastic, to a vitreous stage, clays shrink in drying and burning about one and one-twelfth inches to the foot. Mixed with vegetable matters, the shrinkage under low, long firing, may be figured at from three-fourths to seven-eighths of an inch to a foot.

When fibrous matters, largely in excess of granular prevail, the mixture may be safely expressed from the machine in columns ten or twelve feet in length, and although in drying the column shrinks quite as many inches upon its bearings, it will not rend or crack, but will crawl safely to its centre, *i. e.*, *into itself.*

Greater strength to resist transverse strains, is also observable in this burned product, owing to the form and uniformly parallel positions, assumed by the enclosed air interstices.

CHAPTER IV.

FORMULAS.

The prescribed treatment in manufacture embraces six successive processes, which are known as:—

First. Preparation of raw materials.
Second. Milling.
Third. Pressing.
Fourth. Drying.
Fifth. Firing.
Sixth. Tooling,

which, with the exception of the two first named, differ so slightly from the other in the making of the several products, that one and the same description, save the exception noted, will answer for all.

PREPARATION AND MILLING.

Clay and saw-dust are so unlike in general character, that care must be observed in their commingling, to secure homogeneity in the plastic mixtures, as the excellence of the burned ware depends largely thereon. Particularly is this found to be true, of kaolinic or fictile clays, which are of so stubborn texture, that of them, a more thoroughly milling process is demanded, than of surface varieties.

TERRA COTTA LUMBER.

To effect their incorporation with the vegetable matters in the most satisfactory manner, the use of the "Chaser Mill" is recommended, which moves upon the principle of the Mexican "Arrastre" used for pulverizing ores, and is so thorough in its performance, that intermingled foreign substances, as pebbles, are reduced to the consistency of the clay.

These fictile clays being very pure, require a larger proportion of vegetable matter in their adulteration than other kinds; two parts of saw-dust, to one of clay being equivalent to three, to two, of surface

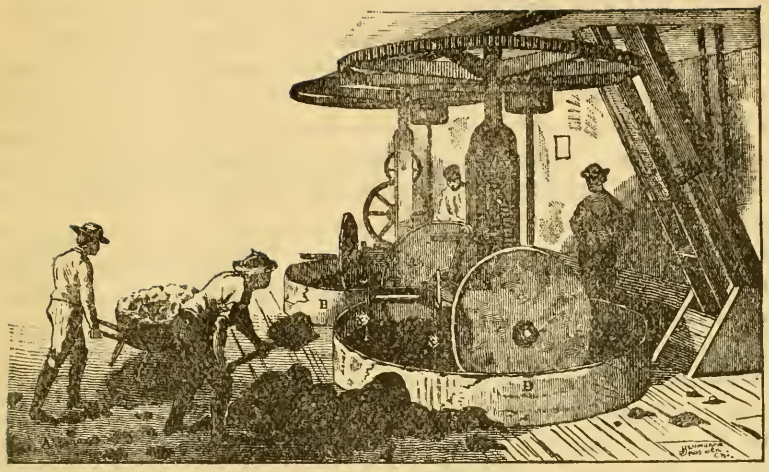


Fig. 1.

clay mixtures, and even then, their burned product weighs ten pounds greater per cubic foot. To burn them well, down draught kilns or the potter's up draught, is required.

For the Chaser Mill, the clays need not necessarily first be weathered, for freshly cut from the bank, the tough elastic chunks, are quickly reduced to plasticity under its terrific, crushing power, but care must be observed to reject all frozen bits, which slipperily elude the wheels.

The usual load for a mill, is ten or twelve hundred pounds of clay, which may be dumped into the mixing pans simultaneously with double the amount of screened saw-dust *by measure*, and sufficient water added, to afford plasticity to the compound. Around this pan rotate two ponderous iron wheels, which, reciprocally traversing its metal bed, crush and mix the contents in the one operation; requiring about twenty minutes of time for its accomplishment, when the movement of the mill is checked, and the mushy mass, ready for the press, is thrown out with shovels.

This milling process for compounding mixtures, particularly where it is intended to tool the burned wares, is unexceptionally superior to any other known, though the objections urged to its general adoption is the first cost of the machinery, the excessive power required for its driving, and the slow, laborious mode of emptying the pans.

Four mills, costing $575.00 each, are required to feed the press,

and with the other machinery necessary for a plant of fifty tons per day, and steam drying, require a hundred horse motive power.

The burned product of kaolinic clays is superior in its fire resisting properties, but is more expensive than that of surface clays; the first cost, under favorable conditions of manufacture, being estimated at $5.75 per ton. These clays, in the few favored localities where they exist, may be purchased for about one dollar per ton, delivered. Usually they are strongly alkaline, carrying as high as two per cent. (40 lbs.) of potash or soda to the ton. This prevalence of alkali, serves as a flux in firing, in consequence of which, the contents of the kiln rarely burn evenly, and as a result, a greater or less per cent. of waste is incurred in this stage of manufacture. Great heat, too, is demanded, to drive the gases out of the green wares; for if insufficiently burned, the alkalies remaining therein, combine chemically with the lime mortars, used in their building, and cause plastered walls to effloresce; "salt-petering" of outside brick walls, likewise results from the mixture of this description of clays with those of surface formations, in the manufacture of pressed bricks.

CHAPTER V.

CLAYS AND ARGILLACEOUS EARTHS.

Granite rocks, which compose so large a portion of the earth's surface, are, presumably, of igneous origin, and their constituent parts are felspar, quartz, and mica.

Under certain conditions these minerals disunite ; disengage themselves from each other, and severally seeking new alliances, form secondary rocks. Under others, they sicken, and wholly disintegrate, resolving themselves into earths, which subsist vegetation, upon the alkaline matters and gases concealed within them ; plant food, created by this described mineral decomposition.

Felspar in its dissolution, discloses alumina, potash, soda, etc., and water chemically combined. Alumina is the characterizing element of pure clays. These, when freed from alkali, and incorporated with free silica (pure sand), afford fire bricks, crucibles, retorts and other articles, in which, great refractoriness to heat, is demanded; while those comparatively free of sand, fictile and of a greasy feel, find a use in the making of jug ware, crockery and porcelain.

Pure clay deposits, when moved from their original beds, by the action, or wash of water, become adulterated by vegetable and mineral impurities, encountered upon their passage, and in consequence are changed to argillaceous earths—the clays of the brickmaker.

These, if moved, or supposed to have been moved, at the time of Noah's flood, are designated as diluvial—if after, by river floods alluvial—or if by muddy water, slowly precipitated to the bottom of lakes—sedimentary. All, however, are recognized under the general appellation of surface clays.

Of these and of the clays of the secondary geological period (fire and fictile) there are one hundred and thirty-eight classified varieties.

Successful brickmaking, therefore, requires at the hand of the worker, an intimate knowledge of the characteristics of his own particular clay bed, which for a certainty, cannot be calculated as

identical in every respect with others, even in the same immediate neighborhood. Ancient brickmaking, embraced both burned and unburned products. "Go to, let us make brick, and burn them thoroughly," was remarked by the builders of Babel's tower, before commencing their labors, and it is in this region of the Euphrates and Tigris, archæological remains of this character are found.

The Babylonian bricks were also burned, while those of Ninevah were sun-dried.

The bible teaches, also, that sun-dried bricks, or "Adobes," were extensively employed in Egypt ; and that the enslaved Israelites were tasked to make such bricks, in which straw was mingled with clay, to insure the durability of the bricks.

Since those times, machinery has quietly supplanted hand labor in working clays ; this, particularly, has been done, in the days of the present generation.

In any process of clay-working, none is so necessary to insure a satisfactory product as the preparation of the clays for moulding, and none, so far as possible, so presistently ignored. These shirking practices are not allowable in the manufacture of Porous Earthenwares.

"Weathering," is the term descriptive of the change with clays, after digging, undergo by exposure to the atmosphere ; to the sun's rays, rain and frost, when piled on open ground, to the depth of a foot or more. This process of pulverization is imperative, with many varieties of clays, particularly of the fictile sorts.

For reducing green surface clays, to a like state of pulverization, powerful machines are substituted, crushers, rollers, disintegrators, etc., and this process must always be preliminary to that of mixing with vegetable matters, except where "Chaser Mills" are used, which, by the peculiar traversing motion of the wheels, grind and mix simultaneously.

BRICK WOOD.

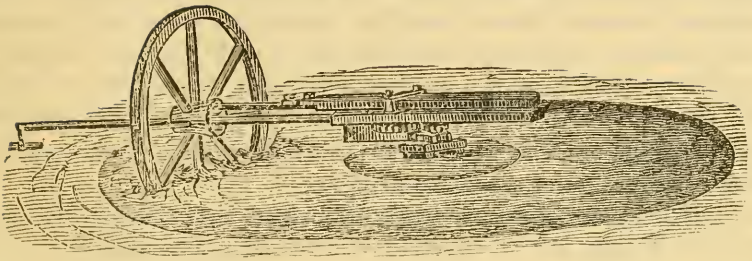


Fig. 2. Tempering Pit.

The costly experiment, necessary to perfect the manufacturing processes of Terra Cotta Lumber, led to the discovery that inferior wares could be made of "surface" clays and saw-dust, at a cheaper cost, and greatly reduced expense of plant, in consequence of change in machines and methods.

Their fire resisting qualities, however, are equal to those of common building brick; practically sufficient for architectural work, in the opinion of builders. The mixtures, and methods of preparation differ materially from those of Terra Cotta Lumber. The clays may be of any, of the many alluvial and sedimentary sorts of which common brick are made, indeed of many which are not adapted to brick-making; those comparatively free from sand, affording the best product. If the clay be very fat, or of the "joint" varieties, an improvement in their working, may be assured, by adulterating with loam or black soil. All clays, for all purposes, work better after weathering, *i.e.*, exposure to the elements, until a thorough disintegration of particles ensue; in this instance, however, this condition may be anticipated by machine treatment.

Before the mixture with the saw-dust is attempted, the clays must be crushed or rolled in manner prescribed in brick-making, to effect the disintegration accomplished by weathering, for which various processes are practiced, and a variety of machine power invented.

A number of methods suggest themselves, by which pulverized

clays may be intimately mixed with the saw-dust, and the adoption of either, may be dictated by the present facilities which the proposed manufacturer enjoys, and the peculiarities of the clays he may be working. The best known in summer brick-making is, by "tempering" in large shallow circular pits dug in the ground, known as soak-pits by brick-makers. In them a large iron wheel rotates about a common centre, and with reciprocal motion slides back and forth upon its axle, from the centre of the pit to its extreme circumference. With weathered clays, or those described above, an extremely effective mixing method. The pit should be filled with alternate layers, in proportions needed, of the earthy and vegetable matters, to which water from time to time may be added to afford desirable plasticity.

Provisions must be made for draining the bottom of the pits and and relieving them of excessive moisture.

Simpler than either methods described, and cheaper in most instances, though not so effective in promoting homogeneity, is the following, which is illustrated in the cut of plant accompanying Brick-wood:—

Upon a smooth floor, cleanly swept, deposit a layer of the pulverized earth, perhaps three inches in depth. Next to, and on top of this layer, add one of screened saw-dust, of equal depth or more, dependent upon the amount of porosity required of the burned product, dampening the same, and the earthy layers as well, if they be dry, by freely sprinkling with the hose, or from a large watering pot. Then again add, of the same thickness, a second layer of clay, and again on this, a succeeding layer of saw-dust, until a pile of alternate layers, five or six feet in height, may have been reached. An amount equal, if care has been had in planning the area covered, to a day's work for the press—say thirty-five tons of clay, the vegetable matters counting for naught. Over all, spread wetted blankets, or old carpets, which must be sprinkled at times to prevent evaporation.

About forty-eight hours time will be required to ripen the mass and allow the moisture to become evenly diffused through every part, if the proper amount of water has been administered.

It is now in proper condition for pressing, and men with sharpened shovels, mounting to the top of the pile, slice down and off, thin sections from the end, or side of the pile, which, tumbling over on the floor, are vigorously stirred and agitated, as the workmen with shovels move the mixture toward and into the "mixer."

If the distance to the machine be a long one, the material may be forwarded to it on an endless belt, for extreme shoveling separates the

saw-dust, it being lighter, from the clay, and causes it to rise on top.

The saw-dust requires little preparation other than screening out the chips and pieces of bark, which is best accomplished by shoveling it over half-inch meshed wire screens, similar to those employed in screening coal. Unless protected from the weather, and the same is true of clay, the saw-dust will soak up and hold moisture to an extent. which, without the further addition of water commonly added, renders the mixture too soft for profitable press working. Dust obtained by re-sawing lumber is too fine for common purposes, but may be advantageously used in making filtering material.

The saw-dust may be of any wood, but pine and spruce are preferable, as they afford fuel sufficient to burn the clay.

The dust of deciduous woods contain mineral matters—the oak, iron; the maple, potash; etc.—which in firing, makes, under certain conditions, mischievous work. Cottonwood, basswood or linn, gum, etc., answer every purpose, save in yielding as much heat as resinous wood for firing purposes.

As the clays suited to Brick-wood making, are common to every section of the conntry, no commercial value is accorded them, save that created by the expense of digging and transportation. It is common however, in making up estimates of the cost of manufacture, to rate the clay and sawdust necessary to make

One ton of wares at - - - -	$1 00
Add to this for labor and salaries, -	2 00
Fuel for steam and kilns, oil and waste, -	1 00
	$4 00

One employe, to a ton of product is here calculated. One ton of wares, is equal in bulk, to twelve hundred and fifty bricks.

The machinery and power necessary for a plant for Summer working only, is a forty horse power engine and boiler, a "crusher," "mixer," and press, all costing in the neighborhood of two thousand dollars.

The cheap kiln, with standing walls, in use for brickmaking, serves every purpose. If, instead of a brick-maker's season, which is limited to the months that clay will profitably dry out of doors, a full year's run of the premises is desired, the factory building must be planned accordingly and artificial heat relied upon for making operators comfortable, and drying the wares.

An estimate of the increased cost may be made, by applying to the company.

CELLULAR POTTERY.

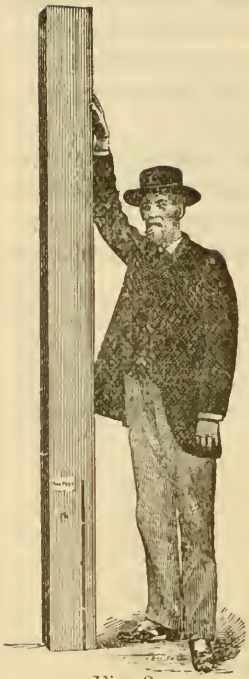


Fig. 3.

Preparation of mixtures for Cellular Pottery, needs no detailed description, as the formula is identical with the one just given, with the difference only, that the short cut straw, or its equivalent, is substituted for saw-dust; a substitution, however, that works a marvelous change in the manufactured product.

The straw or hay, or like fibrous vegetable matter, is prepared for the mixtures, by being cut by a machine into lengths of from one to three inches. Its use was originally conceived, as a substitute for saw-dust, in countries where saw-dust does not abound.

Experiments in pressing, led to the discovery that mixtures containing straw, when passed through an "augur press" were so influenced by its peculiar motion, and the friction occasioned thereby, that the straws were straightened in the delivery through the dies, and the green pressed product thus delivered to be packed so closely with them, that assuming the function of fibres, they hold the clay so tenaciously together that the usual cracking of green wares by the shrinkage accompanying drying, was rendered next to impossible.

This fact was made so apparent that the use of this mixture for the manufacture of dimension, or long stuff like that of pine lumber was suggested, and proved practicable.

Lengths equal to ten or twelve feet, or any which may be conveniently handled in the dry and firing kilns, may be turned out, as illustrated in Fig. 3, which is a reproduction of a photograph of a man supporting such a piece.

In this connection, we shall again have occasion to speak of this material in a future chapter.

The plant for working Cellular Pottery, is the same as described for Brick-wood, but added thereto must be a straw-cutter, which, if run by power will cost one hundred and fifty dollars. The wares are penetrable by nails, but not easily tooled, for the homogeneity of raw materials, obtained in the other mixtures is not acquirable, consequently the material must be formulated into desirable shape, by the impression of the dies when the mixtures are plastic. Nor does the straw alone, unlike the saw-dust, supply all necessary fuel purposes in baking the wares, though it assists materially.

If rafters and floor joists of wood be supplied, the prairie farmer of Iowa and Dakota, need not go off from his own lands, for the building material of his houses and barns, for the loam which lies under and next to the black soil, and the waste straw pile in the fields, manipulated by a machine plant, erected quicker and at a cheaper cost than a portable saw-mill, will supply all foundations, outside and partition walls, floors, as well as chimneys, and ceilings, and walling, for the well and cistern. A warm house in the winter, a cool one in the summer, and as the word goes, fire-proof.

Fig. 4.

HOLSTEIN.

The German word "Holstein" (wood-stone), is given to the fourth and last described composition of Mr. Gilman's. More valuable than any perhaps, of all that have heretofore been described, inasmuch as, added to the qualifications of the others, it contains one, essentially its own. It is composed of clay, straw and saw-dust.

The process of its making, is essentially that of Brick-wood, save that about two bushels baskets full of cut-straw are added to each thousand pounds of clay. It is made of common clays like Brick-wood, possesses fibre to prevent cracking of green wares like Cellular Pottery, can be tooled after firing, like Terra Cotta Lumber, and may be made into large hollow blocks for the outside walls of houses, which by subsequent treatment are made weather proof, and resemble blocks of stone. The cost of manufacture is not materially greater than of Brickwood, and the same plant required, as for making Cellular Pottery, with the addition, perhaps, of a couple of saws, turning lathe, and pony planer with tonguing and grooving attachment.

PRESSING.

This process is performed by "presses of expression," which enforces a motion to the plastic mixture, and at the same time subjects it to great pressure, and the friction necessarily encountered in their passage through the machine tends greatly to blend the earthy and vegetable matters, so extremely unlike, together.

This important service cannot be performed by presses of "compression," like the common brick press, which are therefore not used; though in making irregularly shaped blocks, that cannot be formulated with dies, fair results with granular mixtures may be had by pressing by hand into moulds; at best a laborious, and expensive process.

"Presses of expression," which are of the sort used in making sewer pipes and drain tiles, involve the principle of motion, recognized by clay-workers as the "Plunge" and "Auger" movements respectively. Each movement has its own advocates, as has, in fact, every machine under either principle, of which there are many.

Manufacturers must observe, however, that if a good, firm, burnt product is expected, it will be due to stiff pressing, otherwise the texture will be weak, and the tenderness of the wares, show itself in transportation, and handling.

If entirely new construction accompanies the erection of a plant, it will pay the investor, as it always does in like cases, to visit the factories of present licensees, in person or by proxy, and by examin-

ation, decide upon the merits not only of these machines, but of others, which may be believed necessary for the new plant. If old brick or tile works are to be transformed for the new industry, economy may be studied by converting the presses on hand to the needed purposes, oftentimes at little outlay.

The cost of these presses vary from five hundred dollars, to fifteen hundred each, depending upon their individual capacity for work, and the number of dies accompanying each.

The "Plunge Press" has been described in a previous publication, and we will now devote our attention to one of the other sort, the build, and working of which, may be thus described:—

Cast cylindrically of iron, and shaped not unlike a large piece of ordnance horizontally placed, its proper position is found on the factory floor, within easy distance of the prepared material, which workmen shove into the hopper over the entrance at its larger end.

Adjusted in its interior, and occupying nearly the full length of the cylinder, is a heavy horizontal shaft fitted with blades pitched to an angle of fifteen degrees toward the small, or delivery end, making it in some degree to resemble a mammoth screw or augur bit. This armed shaft, revolving slowly on its bearings, pushes with great strength forward to the small end of the cylinder and through the die, the mixtures received in the hopper.

The dies are made of steel, can be framed of almost any desired pattern, and are attached by simple devices, to the small end of the cylinder; are easily removed and interchangeable.

Pushed from the press through the die with steady and constant motion, the mixture emerges upon a long narrow table, placed in position to receive it, as a shapely column of the identical form of the aperture it has just left, and of such solidity that when divided into sections of convenient size they may be removed to the drying room without the aid of "pallets," or wooden trays, generally used for "off-bearing."

The density of the column, owing to the presence of so much vegetable matter, renders its divisions with the tightly-stretched wire used to cut pure clay products impossible; indeed the fibrous mixtures are with great difficulty cut with a knife. A swinging buzz saw is therefore placed over the farthest end of the table, twenty-five feet or more away from the press. The top of the table being fitted with a series of small rolls, placed close to each other, but not touching, affords easy transit for the column, resting upon them, on its way to the saw.

So often as eight or ten feet of it are projected from the die, it is cut in two with a hand-saw, and the severed piece pushed forward to the buzz saw, whose attendant cuts and removes it in gauged lengths.

The average daily capacity of this press is equal to twenty-five tons of burned ware, and twenty-five horse power is required to drive it.

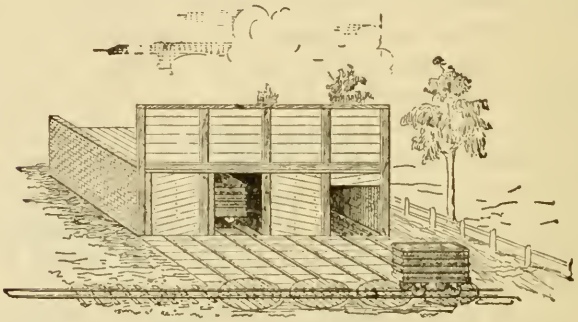


Fig. 5. Drying Kiln.

DRYING.

Open air, in seasons and latitudes which will permit, affords the best and cheapest drying methods.

The turning of the material being unnecessary, no requirement exists to facilitate this process, beyond those supplied by wooden racks. erected beneath cheap shed-roofs, which will exclude rain but freely admit air.

Sixty hours of such exposure in drying weather suffices, and renders the pressed material ready for the kilns.

In northern climates, Winter work must be necessarily pursued in close buildings, artificially warmed and provided with drying rooms.

Up to this time, the most reliable artificial agency known for heating them, is afforded by steam.

If the factory be roomy, containing storage capacity for a week's

run, dead or exhaust steam, which will afford a temperature of 85 deg. F., serves every purpose. The factory of the Minnesota Terra Cotta Lumber Company, at St. Paul, is thus heated, and is run comfortably the year around, even with the mercury at 40 deg. below zero. The factory at Pullman, Ill., is but one-storied, the drying kiln is in one end of the building and on its main floor; is fifty feet wide, eighty feet long and seven feet high. Cars loaded with green material are run in on railroad tracks, and the material dries easily in twenty-four hours. The room is heated with steam direct from the boiler, and the temperature steadily maintained from 125 deg. F., to 200 deg. F., without damaging the contents; a statement, which to the practical clay-worker, seems hardly credible.

The cars employed carrying the material are ingeniously constructed of iron gas pipe. The inventor of it, Mr. John Hayward, of Kensington, Ill., is the Superintendent of the Illinois Terra Cotta Lumber Company, and has patents pending for the invention.

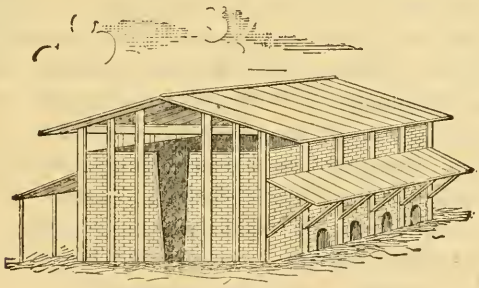


Fig. 6. Firing Kiln.

FIRING.

Where the proportions of resinous saw-dust to clay are equal or more, they are sufficient to burn the former without the aid of other fuel, save in burning off the water smoke, *i. e.*, driving out the moisture, in the shape of steam.

Unlike building bricks, which are burned by the heat generated in arches, Brickwood and Holstein, burn from their own combus-

tion, while Terra Cotta Lumber and Cellular Pottery need assistance from outside fuel Forty-eight hours, or less, after the "water-smoke" has passed away, if looked at through the "peep-holes" the contents of the kiln assume the appearance of a huge live coal, the color of a Richmond cherry, at which stage the fire should be held until the interior of the kiln turns dark, and even longer.

A long continued, low red heat, assures a better "body" than high firing for a shorter time, with no risk of melting the wares.

A remarkable feat attends this process, which is sure to attract the attention of a brick-maker—every piece is burned alike. Those in the corners, and cold places, corresponding in color with those occupying the centre. As a consequence, everything is merchantable and brings one price. Not so with brick.

Heavily moulded bodies should not be burned in the same kiln, at the same time, as those of thinner walls, for the perfect firing of one will surely be to the damage of the other.

Most any sort of kiln answers the purpose of firing; either up or down draught, but in all cases must be so fitted with covers and dampers, that the supply of air to the fire may be controlled. The brick-maker's up-draught, with standing wall's may be preferred, as the most economical and accessible. Those at Pullman and Kansas City are about 140 tons capacity, and cost something more than two dollars and a half per ton to build. Good brick are used for their foundations, but after the walls are high enough to allow of the turning of the arches, the kiln may, with advantage, be completed with hollow blocks of Porous Earthenwares, as the walls constructed of them do not shrink or expand under the action of heat.

The St. Paul Company uses down-draught cylindrical kilns, of the build suitable for burning fire-brick and sewer pipe. They are twenty-five feet in diameter, hold forty tons, and cost some nine hundred dollars each; having been erected before it was certainly known that the material could be successfully fired in cheap up-draught kilns.

The Milwaukee Company burn in brick kilns, with or without brick.

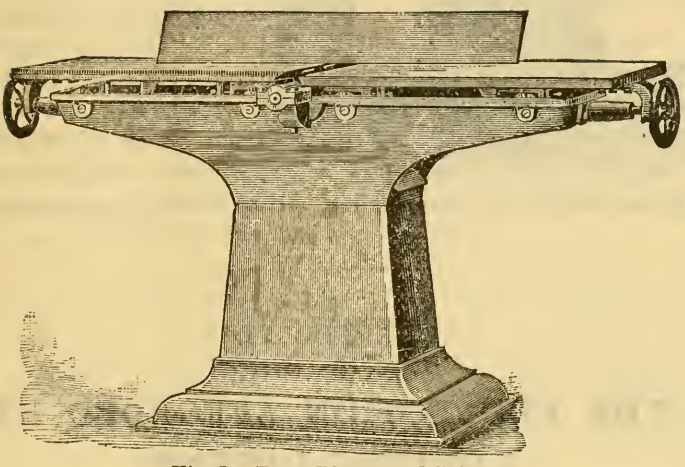


Fig. 7. Pony Planer and Jointer.

TOOLING.

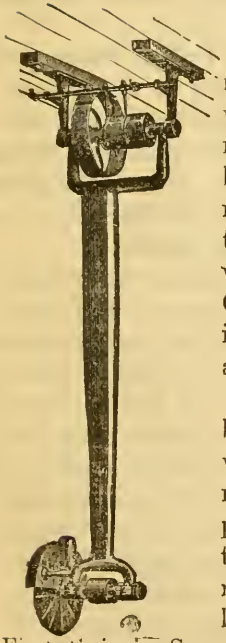


Fig. 8. Swinging Saw.

Terra Cotta Lumber, Brickwood and Holstein, may be sawed, turned, and tongued and grooved with the same tools as is pine timber, with hardly more wear to the tools. If the proportion of clay be greater than their formulas call for, the burned material will be, in consequence, more dense, and the greater the wear of edged instruments used in working it. This treatment is not advised, with Cellular Pottery, though it will receive nails readily, as also will saw-dust products when containing as high as seventy-five per cent. of clay.

With work which requires to be "finished," buzz saws are used for butting and edging. But wide, flat surfaces, are most easily dressed, by running in a plastic state, as nearly to the size as possible, and, after firing, jointing to required thickness, upon a small power-planer. As the material, after firing, possesses no fibre or particular grain, like wood, it matters little about the shape and size of the saw teeth, only, sufficient space should be left between them to allow of easy clearance of dust.

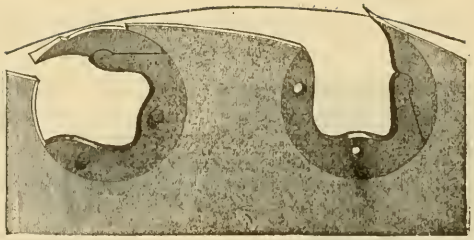


Fig. 9. Removable Saw Tooth.

To avoid the trouble of filing, saws with removable teeth are recommended. The teeth should be tempered by the saw maker, to a shade bordering on straw color, and the tooth, when its usefulness may be ended, is taken out and thrown away, as re-sharpening will be found impracticable.

CHAPTER VI.

THE PROTECTION AFFORDED BY LETTERS PATENT.

The possession of Letters Patent is prima facia evidence that the holder is entitled to them, until it is clearly proven that the originality of the invention began not with him.

Of all countries possessing patent laws, the United States and Germany are the most thorough, and pains-taking, in the examination of claims, and most conservative in their allowance. In consequence thereof, the patentee, of what, in time, proves to be a profitable invention, has good reason to look with confidence to the courts of those countries, in the event of subsequent litigation with infringers, to substantiate the position of the grantor.

Neither expense, nor pains, have been spared by the "International Terra Cotta Lumber Company," as licenser, to furnish ample safe-guards to the manufacturer, in the peaceful and profitable pursuit of his avocation. It is the proprietor of four United States Letters Patents, upon Compositions of Matter—"Bed Rock" patents as they are termed, being the foundation, as it were, of the art, which, in turn, are backed by thirty others, or more, protecting their various specific applications, to architectural, fire-proofing and other purposes. Appended is a list of Letters Patent, granted by the United States, to date. Printed copies of these, and of those pending, after their allowance, will be furnished, upon application, at Department prices, twenty-five cents each. Written copies of foreign patents will be afforded, at cost of copying and translation.

No. 10,419 and 10,420. "Terra Cotta Lumber." Re-issue. First.—A fire-proofing composition made of kaolinic clay free from grit, and saw-dust, of proportions described, mixed with water, pressed, dried, burned, and subsequently reduced to form, with edged tools. Second.—A product, made as above described, of such proportions of kaolinic clays, and saw-dust, and water, that subsequent to the firing process, may be wrought with edged tools.

No. 353,629. "Brickwood." The product and machine process of homogeneously mixing clays, essentially free from sand, and saw-dust, pressed, dried and burned, as described.

No. 353,630. "Cellular Pottery." The product, and any process of mixing straw, clay, water, pressing into form, drying and burning.

No. 353,631. "Holstein." The product, and processes of mixing clays, straw, and saw-dust, and pressing, drying and burning the same, so that the resultant material may be worked with edged tools.

No. 163,248. "Fire-proofed Floors," of burned clay material, in which the foot of the iron (I) beam, is enveloped by the skew-back.

No. 304,310. "Fire-proofed Combined Elevator and Air Shaft," which so provides ventilation, that flames and smoke cannot enter the elevator shaft, if located in a burning building.

No. 338,509. "Fire-proofed Wooden Roof," covered with slate or shingles.

No. 338,510. "Fire-proofed Floor and Ceiling," hollow, porous earthenware joists, three pieces.

No. 338,512. "Fire-proof Jackets for Iron Posts and Columns."

No. 338,513. "Floors and Ceilings," wooden joists, fire-proof.

No. 338,514. "Porous Earthenware Furring" for brick walls.

No. 338,515. "Porous Earthenware Sheathed Roofs" covered with cements or asphaltum.

No. 338,516. "Floor Arches," hollow joists, two pieces.

No. 338,517. "Floor Arches," hollow joist, one piece.

No. 340,570. "Air Cooling Roofs," for tropical climates.

No. 332,247. "Fire-proof Storage Vaults."

No. 341;650. "Filtering Well," all water compelled, in its passage into the well, to pass through walls of filtering material.

No. 337,829. "Movable Ceilings." A construction which allows of the shrinkage of floor joists, without endangering the ceilings.

No. 342,595. "Roof Gardens." Superficial floor for roof tops, to enable the growing of grasses or plants.

No. 345,047. "Earthenware Gravel," for deafening purposes.

No. 345,379. "Iron Cored Floor Beams," porous earthenware joist, ribbed with iron.

No. 349,585. "Metal Cored Construction."

No. 349,584. "Mansard Roof." Fire-proofing methods.

No. 341,651. "Filtering Material." Porous earthenware, with charcoal centres.

No. 341,649. "Plan for Construction of Filtering Vats, for Public Waterworks of Cities and Towns."

No. 332,246. "Safe and Vault Linings." Porous earthenware sheathing, saturated with alum.

No. 228,629. "Housing and Insulation Underground Electric Wires." Porous earthenwares, impregnated with asphaltum.

No. 338,518. "Electrical Sub-way," plan of.

No. 328,581. "Jackets for Steam Boilers and Pipes."

No. 340,569. "Sidewalks." Porous earthenware slabs, treated with cements.

No. 338,511. "Pavement and Pavement Foundations." Porous earthenware in combination with asphaltum.

No. 345,046. "Tunnel Linings." Porous earthenwares, made water tight, and laid in asphaltum, as a bond.

No. 216,196. "Fire Kindlers." Covering the use of porous earthenware as an indestructible wick for hydro carbons.

Eighteen patents for other specific purposes, pending.

CHAPTER VII.

PROFITABLENESS OF MANUFACTURE.

The introduction of this new industry, to the public, entails necessarily, some exertion and expense, upon the part of licensees, to bring their wares into notice and into demand locally, but the attention of the world at large, of builders and architects, is being drawn to the merits of the material, and this general advertising soon reaches "our people at home," and ably seconds the efforts of the manufacturer, to illustrate the value of his commodities.

In lumbering, two sources of profit follow the practice of the industry. That derived by the capitalist, who owns the pine lands, from the sale of "stumpages," *i. e.*, the logs which may be on them,

and of the manufacturer, who saws the logs into lumber and sells the product.

So it is with Porous Earthenwares. The party who owns the exclusive right of manufacture to certain territory, owns the timber land of the lumberman, and can manufacture himself, or license others, *i. e.*, sell the stumpage. On the other hand, the manufacturer obtains not only a manufacturer's legitimate profit, but the profits, which in the lumber business, goes to enrich half a dozen middlemen before the tree on the stump reaches the consumer.

It may be observed, by the reader, that the tendency of the treatment of this subject, is to offer a substitute for pine lumber, but none to the lumberman for the loss of the lumber business. That the proposed new industry, insensibly drifts towards the trade of the brick-maker. This does not necessarily follow. Of all known manufactures, brick-making posseses the most ancient origin and is the most lowly. It is an industry to which the employment of capital can afford no advantage, beyond the accumulation and carrying of large numbers. It is the manufacture of the poor man.

The "old country" brick-maker, on the edge of the town, the possessor of a few acres, on which to raise his vegetables and subsist a cow, two pigs, and a dozen hens, from the same acreage obtains his clay, for brick-making, and with the help, added to his own, of an old horse, a hired man, and two sons, will turn out each season, his two kilns of brick for his neighbors, as artistically, and with as much profit, per thousand, as does the millionaire maker of Haverstraw, who helps to supply the great city of New York, with its six hundred millions of brick annually. This "equal chance" business, affords about one money making year in six. Following that year every body goes to clay working, markets glut, prices fall, and those who are well enough off to stay in the business, or too poor to go out, live, and only live, for the five unprofitable years which follow.

Every brick-maker, big or little, starts in with a plain hundred per cent. profit in sight. Half-way decent burning is to afford, in his calculation, at least, of his entire product, fifty per cent. of "stock," or merchantable brick. The cost of the whole kiln is charged to them, and the arch brick, salmon and pale, are reckoned as his profit. Nor is this too large a margin for profit, if actual, for the brick-maker's season is shorter than the farmer's. May 15th to October 15th, is quite as long, in a Northern climate, as he can dodge between showers and frosts. Five months, out of twelve, for earning; seven, out of twelve, for spending.

The State of Maryland, through its Bureau of Industrial Statistics, in a late biennial report, afford, in detailed tabulated form, a statement of daily and annual earnings of every employe in the brick yards, from moulders, pressers, and burners, each at $2.25 per day, to the turn-over boys, at 32 cts. Condensed, as an average for all, the showing is: wages for 159 days, brick-maker's year, $243.60; total year, per day, 78 cents. Rather small wages for the employe, in the absence of any showing that he is able to obtain employment during the remainder of the year. His employer fares no better. His profits cease, when his crew stops drawing pay.

But, now, suppose the brick-maker could profitably pursue his calling in doors, as well as out? In Summer and Winter, continuously, and employ his labor by the year? That every brick in his kilns burned alike? No "hard," no "soft," but all alike, all merchantable? That he enjoyed, some time during the year, a sure demand for his entire annual out-put? That he was protected in his prices, to a certain per centage of profit, and that per centage, was one hundred cents on the dollar of cost price?

Such is the position he can occupy as a manufacturer of Porous Earthenwares, and, if the reader be a practical clay-worker and thrifty, he will give this subject more than a passing thought, before he drops it.

CHAPTER VIII.

CONSTRUCTION OF PLANT.

The cost of the raw materials, which enter into the composition of porous earthenwares, is merely the expense incurred in obtaining them; transportation of straw and sawdust, from their places of growth and manufacture, and digging and hauling of clay. Of course, there are exceptions.

After they reach the factory, no expense, besides labor, is recognized, up to the time of their delivery as product to consumers, save for repairs, and fuel, for steam, and kiln purposes.

The judicious employment of steam or water, as a motive power, enables the cheaper substitution of machine for hand labor, in many of the manufacturing processes.

LOCATION OF FACTORY.

Clay bed, factory and salesroom, can seldom be combined, on one, and the same spot. The raw materials must needs be hauled to the factory, or the factory may be located on the clay bed, and the manufactured goods hauled from there to the salesroom, or to the consumer. A clean saving is manifest in the latter plan, for the manufacturing processes destroy *all* of the vegetable matters, and twenty-five per cent. of the weight of the clay. Some breakage of wares is naturally incurred in transportation, but for deafening purposes, the broken pieces will work in, at actual cost of making and hauling. If clay beds, and saw-dust and straw piles cannot be found contiguous, the preference for location of factory, should be given the former, for hauling rates are usually made on tonnage, and in weight, as compared with bulk, clay rates five to one of saw-dust, and even greater to loose straw.

Two practised clay-diggers will supply the daily wants of a twenty-five ton plant, either to dig and load the clay on carts, with the aid of the driver, or to dig and pile on a conveyer belt, extending conveniently from mill.

If the plant be calculated to do winter work, the clay must in like manner, be accumulated by another gang during the summer months. The same rule usually applies to the supply of vegetable matters. In such instances, instead of running the clay into the house, as practised for immediate consumption, the winter's stock may be accumulated in a long, high pile, outside and close to the factory building; so close, that by cutting a doorway through the building, access may be had to the same, without as it were, going out of doors. Be the weather ever so severely cold, thus piled, the surface of the clay will freeze down only about twelve or fifteen inches, forming a safe roof, for a warm, though dark room, as the daily excavation proceeds. Eighteen to twenty inches in depth of saw-dust piled thereon, will keep the clay-pile from freezing. But as a result, there will be no protection for workmen, as the roof will be continually falling in. The vegetable matters must be stored from the weather.

GROUND PLANS.

This article has now reached a point, where reference to the accompanying ground plan, will materially aid the reader in following further description:

This plan, illustrative of a "Winter Plant," embraces the factory

building proper, (including the drying kiln enclosed therein), the drying yards and firing kiln; the spaces occupied by each, and relative to each other, drawn to a scale. But it will be seen, that the materials when they leave the mixing piles, upon the conveyer belt, take a "straight chute" to the drying kiln, passing through the necessary processes of manufacture on their way.

This is held to be the most economical method of handling, and where the "site" will allow, should be adopted, as the factory being restricted to a single floor, requires no expenditure of power for hoisting, and allows of perfect supervision by the foreman, of the employes who cannot be long out of sight, if attending to their duties. A comparatively frail building may be also made to do duty, the weight of the machinery and material being upon the floor, which should be entirely independent of the frame.

Circumstances many times will interfere, however, with the arrangement of ground, building and machinery, as thus planned, as for instance, when it may be deemed necessary, or to advantage, to utilize second-hand property, which have buildings, and power already are in place. In this event, practical points may be gained by visiting other clay-working factories, before driving the first blow towards improvement, that the desired alterations may be made, with the least possible trouble and expense. A second story, may be made to do duty as a drying-room, or if the building be small, and of three stories, the third story, may be used for drying purposes, and the second as a press-room; but the walls and floors of the building must be calculated upon to carry a heavy load.

G and H, in the drawing, indicate the location of the boiler and engine, placed in a fire-proof annex to the factory, and belted at right angles with, and to the main shaft, which extends lengthwise throughout a portion of the main building.

Good judgment, will dictate, that some calculation be had in the planning of a plant, as to the size to which the business may probably grow in the near future, as well as to the present wants, and this calculation will determine the selection of the power with which to drive it. A full forty horse-power engine and boilers are deemed sufficient for the single plant described; but, the building as planned is sufficiently large for doubling, and if the motive power be calculated of sufficient dimensions in the start, the capacity of the factory, may be increased one hundred per cent., at any time, by adding one thousand dollars worth of machinery, and further drying and burning facilities. A, locates the Crusher or Disintegra-

tor, which in this instance, assumes the place of the "Chaser Mill," so indispensable in the treatment of stubborn clays.

The position of this machine, need not necessarily be at the exact point indicated, but should be where clay received from the bank, can be handily fed to it, and within easy wheeling distance of the mixture piles. To enable the accommodation of clay about it, without incurring stoppage, it may be blocked up from the floor, three or four feet, and should be firmly bolted therethrough, to its foundation, beneath the floor. Its speed may be geared to 550 revolutions per minute.

B, B, B, represents three piles of mixed materials, each containing a supposed day's work of a twenty-five ton plant, to-wit: Thirty-five tons of pulverized earthy matter, and at least one and a half times greater bulk of saw-dust and straw. But if straw alone be used; four times the bulk by measure, as it comes from the straw-cutter.

The form given to these mixture piles, depends upon the room, best afforded in the factory building for their accommodation; but should always be at least five feet high, when freshly piled. In the illustration, the size of the piles is twelve feet by twenty, with alleys between, five feet in width; the boundaries of either, being defined on the floor (which must be dressed to even surface) by lines of bright paint.

Too much emphasis cannot be placed upon the fact, that *brains* are required to direct this part of the business, and give its constant watching; measurement of wheelbarrows must be frequently made, and the quantities of ingredients to each other, nicely adjusted.

Upon the exercise of this care, and watchfulness, depend the quality of the wares; upon their superiority, the reputation of the manufacturer; upon that reputution, the demand and resultant profit. Slovenly ways, and guess-work, may be tolerated in other departments of the manufacture, but not in this. The process is detailed elsewhere.

D is the conveyer belt, propelled on small rolls, by a counter pulley from main shaft, in front of and parallel with, the ends of the mixture piles. Upon this, the material is thrown, with shovels, and conveyed to the mixer E, dropping into which, it undergoes a thorough pugging, in its slow, but constant, progress through, to the elevator belt, at its other end, which catches it as it emerges from the machine, and dumps it into the press F, which here, as described, is of the "auger" variety. From the press, by barrows or cars, to the drying kilns, X X, and from them to the firing kilns, O, which

should be so located, as to receive the green product at one end, and discharge the burned wares, to teams or railway cars, from the other.

For the construction of the burning kilns, above the line of the fire holes, the porous wares will be found superior to brick, for the reason, that being made in large sections, the blocks bind better, have a stronger hold on the mortar bond, and the walls do not contract and expand, in consequence of the heat, applied to the wares.

The factory floor, built independently of its walls, should be constructed on the ground, leveled and drained to receive it.

The covering may be three inch, coarse grouting, finished up with cement mortar, or a sheathing of three inch slabs of Porous Earthenwares, first immersed in boiling asphaltum, to render the material waterproof; the upper surface of the slab floor being, subsequent to laying, treated with an inch coating of asphalt mastic.

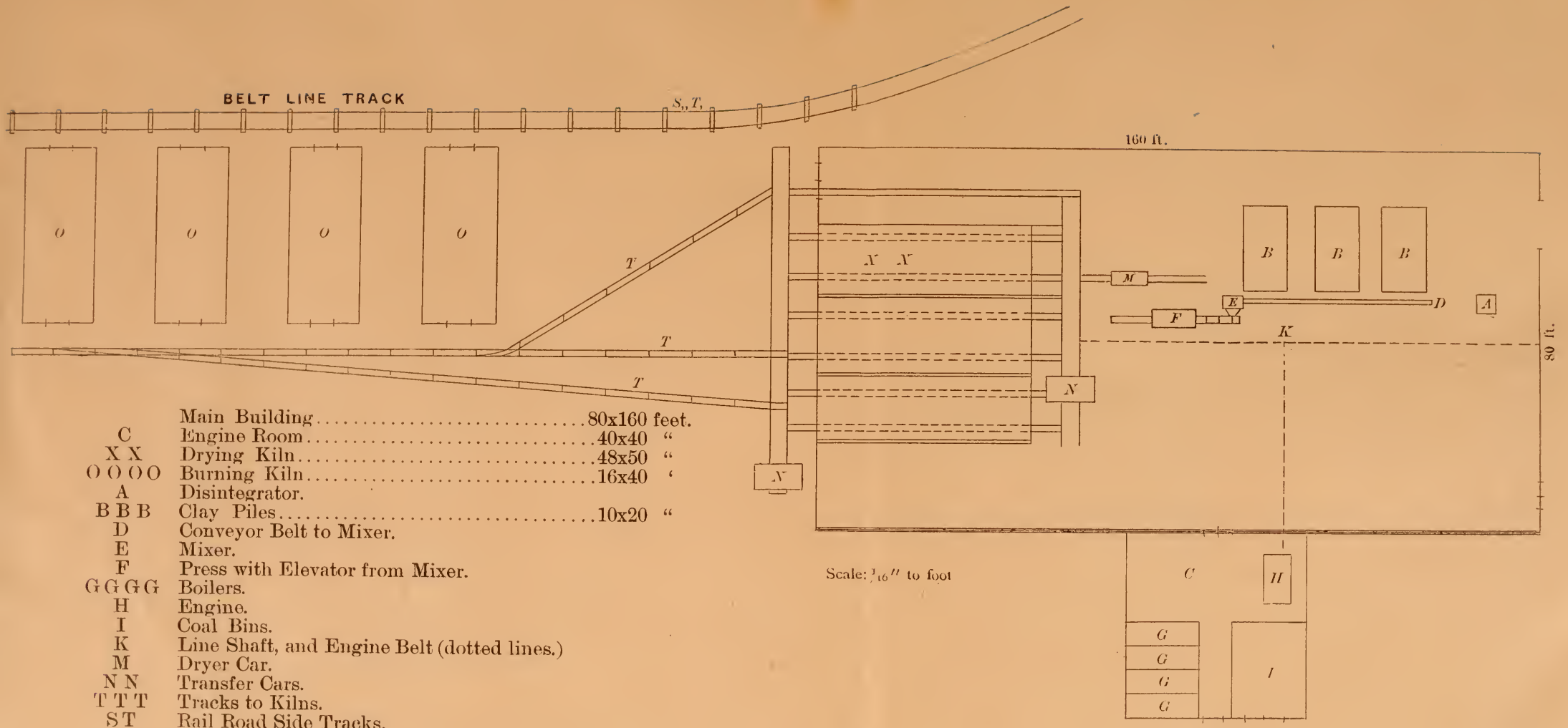
Every machine in the factory must be solidly mounted on a foundation of brick or stone.

Sheds, independent of the main building but adjacent, must be built, to protect from the weather, the accumulated vegetable matters, and in them may be located the straw cutter, to be propelled by hand, or by steam power transmitted from the main factory building.

Where time will allow, it will be found to be of economy, to cover the machines with a cheap protection against the weather, in starting business, and from them, to turn out the material for permanent construction; insuring superior materials, and, at the same time, enabling an exhibit of the wares, in structural form, to be afforded to patrons, who may need a practical illustration of the kind, as convincing evidence of some, to their minds, doubtful points. "Seeing is believing!"

The figures furnished in preceding chapter, on the cost of necessary machinery, by no means represents the cost of a plant. The machines must be delivered, set in place, foundations built and attachments made. Buildings are to be erected, and railway tracks, kilns, cars, and tools provided; all of which, costs money, even if the real estate for location, costs nothing. If it does, that too, must be added.

The first thing for the investor to do, is to carefully make up his mind as to what is wanted; second, to obtain from a competent architect, working plans, and estimates of cost; third, to contract the work at a fixed sum to men accustomed to such business, in fact; to practise the same precautions, against incautious outlay, as observed in other like transactions.



	Main Building	80x160 feet.
C	Engine Room	40x40 "
X X	Drying Kiln	48x50 "
O O O O	Burning Kiln	16x40 "
A	Disintegrator.	
B B B	Clay Piles	10x20 "
D	Conveyor Belt to Mixer.	
E	Mixer.	
F	Press with Elevator from Mixer.	
G G G G	Boilers.	
H	Engine.	
I	Coal Bins.	
K	Line Shaft, and Engine Belt (dotted lines.)	
M	Dryer Car.	
N N	Transfer Cars.	
T T T	Tracks to Kilns.	
S T	Rail Road Side Tracks.	

Scale: $\frac{1}{16}$" to foot

GENERAL INFORMATION

CONCERNING

POROUS EARTHENWARES.

One ton of Porous Earthenwares equal in bulk (laid up in wall) 1250 ordinary building bricks, and weigh less than one-half—and in comparison with pine lumber, contains 550 feet board measure, weighing twice as much.

The cost of erection, including mortar, averages fifty per cent. of the cost of brick masonry.

Fifty cubic feet, or more of it, weighs one ton or 2,000 lbs.

Its weight per cubic foot, is 42 to 50 lbs.

Building brick weigh, per cubic foot, 120 to 130 lbs.

Freight rates by rail and water, are the same, per ton, as for bricks, the classification being the same; hence thrice the amount of it in bulk, may be transported for the same money.

In the form of hollow blocks, the weakest (Holstein) maintains a crushing weight of 4,000 lbs. to the square foot, of the strongest (Cellular Pottery) 12,000 lbs.

The factory prices of Porous Earthenwares, in the rough, may be fairly estimated at $10.00 per ton. If tooled, an added price, commensurate with the expense incurred.

$10.00 per ton, equals $18.00 per thousand for lumber.

$10.00 per ton, equals $8.00 per thousand for brick in the pile. When laid up, $1.50 per thousand less, owing to the cheaper cost of erection.

POROUS EARTHENWARES.

The Illinois Terra Cotta Lumber Co.

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QUINTIN JOHNSTONE, Manager. JOHN HAYWARD, Superintendent.

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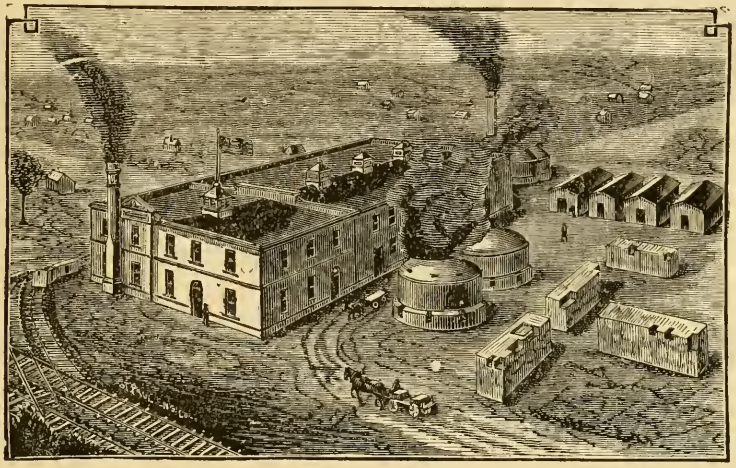

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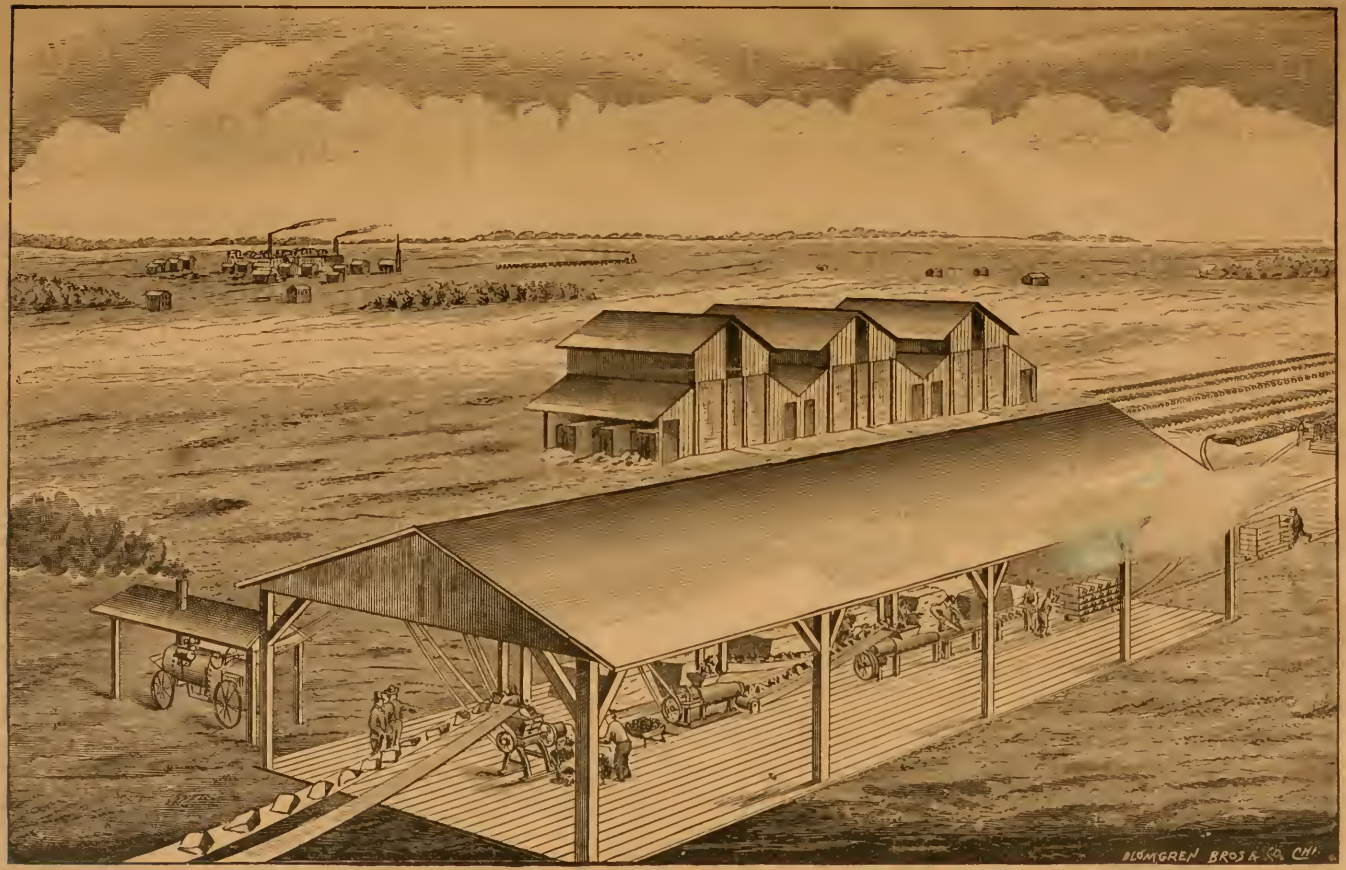

SUMMER PLANT FOR THE MANUFACTURE OF POROUS EARTHENWARES.